IV.3. Adjunct Proposals

A. Electricity From Landfill Gas and Other Biogas; Climate Active Gas Mitigation in Utility Restructuring

Submitted by: Sacramento County, Yolo County, Monterey County, International Power Technology, Royal Farms, Institute for Environmental Management, EMCON

Preface

This proposal specifically addresses renewable electricity from biogas as an avenue to reducing climate active (or "greenhouse") gas emission in the restructured electric utility industry.

The proposal is intended to serve as an adjunct to any of the other candidate proposals from the ad hoc renewables working group which address the wider range of restructuring issues connected to the proposed Renewable Energy Credit.

1. Interpretation of Commission Goals; Relationship of this Proposal to Commission Goals in Restructuring

The CPUC, in its Restructuring Decision of December 20, 1995, commits to fostering electricity from renewable resources. The commission's decision clearly allows for development of strong roles for diverse renewables, including wind, solid biomass, geothermal energy, photovoltaics, solar thermal, and others. A major justification for renewables' use is their environmental benefits, including, importantly, their mitigation of the climate effects of fossil fuels.

Among the renewable energy resources already significant in California is electricity fueled by "biogas" derived from the decomposition of various organic wastes. This document first discusses the current and potential future role of renewable electricity from biogas within the restructuring industry. The purpose is to provide an overview of the status, and particularly the existing environmental issues, with electricity from biogas. It then proposes an approach to maximize climate change benefits from electricity from biogas within a restructured industry. Restructuring implications of the approach are presented.

2. Program Background, Overview and Description

a. Electricity from Biogas in California

Methane rich gas, ("biogas"), is produced by microbial decomposition of organic wastes including municipal solid wastes, manures, and sewage sludges. In this document, biogas is considered to include all methane-rich gas generated by microbial action from existing wastes, whether in landfills, or anaerobic digestion of manures, sewage sludges, and other wastes such as from food processing. Such biogas can and does already fuel electricity generation in a variety of commercial equipment, with present prime movers including internal combustion (IC) engines, combustion gas turbines and steam turbines.

Approximately 200MWe of net capacity are fueled by biogas in California. The largest category (about 75%) of biogas-based generation is at municipal waste landfills, from "landfill gas" (LFG). From statistics developed in cooperative solid waste industry/USEPA-sponsored work, present and contracted generation capacity of the landfill gas industry in California is as shown in Table 1. Electricity from the anaerobic digestion of sewage sludge and food waste may be about 25-30 MWe and from manure biogas presently about 1MWe. The electricity from biogas is nearly all baseload (85% or greater annual capacity factor) as biogas, which is non-storable, is typically collected 24 hours/day.

b. Electricity from Biogas, Atmospheric Methane Emission, and Climate Change

Renewably based electricity is designated a "public purpose" program by the CPUC. One major public purpose justification for renewables is environmental benefits accruing from their use. One environmental benefit of renewables, now seen as extremely important, is addressing climate change by reduction or mitigation of the emission of climate active gases. Mitigation of climate change and climate active (i. e. "greenhouse") gas emissions has become a major state, federal and international concern, as well as the subject of a major international agreement[1] It is an electric utility concern, such that nearly all California utilities are signatories to the voluntary U. S. Climate Challenge program, whose major purpose is to reduce climate active gases.

In brief, recovery and use of biogas for electricity generally provides corresponding reductions in emissions of methane to the atmosphere, as discussed in more detail in subsequent sections and notes. Conversely, without biogas energy uses, major sources of biogenic methane emission escape control either partially (landfills) or entirely

[1]The United States is signatory to the Rio Treaty, (Framework Convention) wherein it has agreed to actions to ensure that greenhouse gas emissions in the year 2000 do not exceed 1990 level. It is very likely that the U.S. will be in violation of this treaty condition by 2000.

(manures)[2]. As a "greenhouse" gas, methane's potency on a weight basis is over twentyfold that of carbon dioxide. Thus capture and use of biogas from these sources helps substantially in addressing global warming. Reduction in methane emissions also addresses other adverse

[2] Even with numerous extant air emission regulations, no statutes or regulations (local, state, or federal) address atmospheric methane emissions per se; methane abatement instead subordinates to control of other biogas components (VOC's). Unless air pollutant emissions dictate control under statutes, major emitters of methane may escape control entirely.

TABLE 1. LANDFILL GAS ELECTRIC GENERATION IN CALIFORNIA
(Net megawatt capacity at site; typical sites average 85% [or more] of net capacity annually) (Source: Thorneloe and Pacey, 1996)

SITE	NET CAPACITY, MWe
Altamont, Contra Costa County	5.0
American Canyon, Solano County	1.55
Austin Road,	0.75
BKK-1, Torrance,	3.4
BKK-2, Torrance	6.4,
Central of Sonoma County,	6.0
Central of Yolo County	1.8
Corona	2.0
Coyote Canyon, Los Angeles County	12.0
Crazy Horse, San Luis Obispo County	1.28
Guadalupe, Santa Clara County	2.5
Marina, Monterey County	1.9
Marsh Road, Santa Clara County	2.0
Mountain View, Santa Clara County	3.0
Newby Island, Santa Clara County	4.0
Olinda, Orange County	5.0
Oxnard Ventura County	5.25
Otay, San Diego County	3.4
Palo Alto, Santa Clara County	1.2
Palos Verdes, Los Angeles County	7.0
Penrose, City of Los Angeles	8.5
Puente Hills, Los Angeles County	47
San Marcos, San Diego County	1.32
Santa Clara, Santa Clara County	1.42
Santa Cruz, Santa Cruz County	0.66
Spadra, Los Angeles County	9.0,
Sycamore Canyon, San Diego County	1.32
Temescal Road,	1.31,
Toyon Canyon, City of Los Angeles	8.5,
West Contra Costa, Contra Costa County	2.6.
	Total 157

phenomena, particularly stratospheric ozone depletion. Most relevant for the electric utility sector, methane emission mitigation resulting from biogas-to-electricity provides uniquely large per-kilowatt "offset" to otherwise adverse greenhouse effects of fossil CO_2 emission from electric power generation. Fueling an estimated potential of 600MWe or more of California electricity with biogas will offset about 10% of the fossil CO_2 emissions associated with electricity generation in California (further discussion in Note A-1)

c. Recognition of Biogas Benefits

The climate change benefits of electricity from biogas are well-recognized by the electric utility industry and utility trade organizations. (Note A-2). These climate change benefits are also recognized and promoted in an array of government programs and initiatives (Note A-3). As but one example, four (of 50) action items in the 1993 Presidential Climate Change Action Plan deal with energy uses of biogas.

The Intergovernmental Panel on Climate Change (IPCC) working value for methane's greenhouse potency is about ninefold that of CO_2 on a molecule-for molecule basis, or a factor of 24.5 higher than carbon dioxide on a weight basis; (these values are also used by the U.S. EPA and United States Department of Energy [DOE]) Based on this, generation of one kWh from biogas as opposed to its emission to the atmosphere effectively offsets carbon dioxide emissions from about 10kWh of fossil fueled power[3].

This CO_2 mitigation or "offset" associated with electricity from biogas is well-accepted. It is quantified and reported by most U.S. utilities purchasing and reselling electricity from biogas, as well as their trade organizations. The most active electric utility trade organizations on this issue are the Edison Electric Institute, (EEI), representing Investor Owned Utilities (IOU's), and the Electric Power Research Institute (EPRI). Greenhouse gas mitigation programs of utilities and others are reported under the U. S. Department of Energy's Title 1605 (b) voluntary reporting program for greenhouse gas mitigation efforts. Under the program, methane use reported with electricity from biogas is all taken as equivalent to abating 24.5 times its weight in CO_2 (the standard IPCC/EPA/DOE methane greenhouse value).

d. Monetary Valuation and Cost Effectiveness of Biogas Climate Benefits

"Standard" values are not established for greenhouse gas reductions, but there are several present yardsticks. Valuations (i. e. debits) have been assigned to greenhouse gas

[3] Ninefold offset from methane abatement plus backing out CO_2 from one kWh of fossil power generation. As noted briefly in A-1, it is nearly all fossil fueled power that is displaced by renewables.

emissions in electric resource planning by several states' public utility commissions in the U. S. These have normally been expressed in dollars per ton of fossil CO_2 or dollars per ton of fossil CO_2 emitted or abated, or, when another greenhouse gas is abated, its CO_2 equivalent[4]. (Values are being assigned in Europe, also. These are typically higher than U.S.) In addition, numerous U. S. utilities have undertaken voluntary projects for the specific purpose of greenhouse gas abatement at various net costs; one example is the "utilitree" tree planting program involving Edison Electric Institute members[5]. A number of studies estimate costs of slowing climate change. A comprehensive summary of several studies is published by Nordhaus (1991). Based on studies such as summarized by Nordhaus, costs of up to 25 dollars per ton of CO_2 carbon ($6.80/ton CO_2) might be considered in the "low" range of costs for CO_2 abatement.

Further discussion of greenhouse gas offsets is presented in Note A-4. Example calculations for offsets associated with biogas based generation in Table 2 of Note A-4 show values from 1.4 to 7.5 cents/kWh at equivalent CO_2 abatement costs of $2.75 to $5.50/U.S. ton. As discussed in notes A-4 and also A-5, biogas use for electricity does generally result in abatement of atmospheric emissions, and so, represents net "public good" in terms of not only the greenhouse gas but also VOC offsets (Notes A-4 and also A-5).

e. Current Economics and Status of Biogas

Though climate change benefits from biogas to electricity are widely and officially recognized, markets for electricity to grids have been sufficiently adverse, or uncertain, that most biogas from landfills and other wastes still does not find use. Survey work (Thorneloe and Pacey, 1994) has indicated that, as of 1994, only about 300 MWe of landfill-gas-based generation were realized in the U.S. out of a U. S. potential estimated by both the U.S. EPA (EPA 1993) and the Electric Power Research Institute (EPRI, Gauntlett, 1992) to be 5000-7000MWe[6]. Part of the problem, noted above, is that landfill regulations address only local air pollutants. There is also no direct regulatory authority, or monetary incentive to prevent biogas' greenhouse methane emissions per se to the atmosphere. Another major barrier is economics. Electric power development from many landfills and manure streams--that now emit a great deal of methane to the atmosphere--is more expensive than electric revenues of themselves would justify. This is because of small scale and many other site-specific factors. Combinations of uncertainties and costs have been such that, even with past favorable SO4 electricity

[4]For example, the State of Wisconsin Public Utilities Commission assigns a debit of $15/ton CO2 ($55/ton CO2 carbon) and $150/ton methane emission prevented in electric resource planning. New York Public Service Commission considers a guideline of $20/ton CO2 carbon (5.50/ton CO2) In California, carbon abatement values of $30/ton are considered (Electricity report docket 93-er-94, June 7, 1994).
[5] Personal communications, John Kinsman, EEI.
[6]Potential in EPA and EPRI refs based on size criteria (>1MWe) and presuming favorable power markets.

purchase prices (applicable in some cases), and past tax credits[7], electricity from landfill gas in California developed only about 150 MWe out of gross potential of perhaps 500-700 MWe (for estimate basis see Note A-6). For biogas from manure, percentage of methane recovered to generate electric power is much less than 1% nationwide (Roos, 1995).

Another issue arises as the California electricity industry restructures. In states where utilities remain integrated, and subject to states' Public Utility Commissions' controls, it has proven possible for such integrated utilities to promote greenhouse gas and biogas abatement in projects through Commission directives and guidelines. With present restructuring in California, it is not clear what entity might have responsibility for additional greenhouse gas abatement efforts, beyond those consequent to application of the REC's as now envisioned. To address this situation, a possible approach, developed below, is to adapt REC's to accomplish additional desirable climate active gas abatement.

f. Statutory Authority to Value Emission Abatement

As noted in several other Renewables Working Group proposals addressed to the CPUC, there exists statutory authority to value environmental benefits of specific generating technologies. The California Public Utilities Code states**:**

> -In calculating the cost effectiveness of energy resources, the Commission is directed to include a value for any costs and benefits to the environment, including air quality [sect 701.1 (c)]

g. Greenhouse Environmental Credit (GEC)

Significant monetary values are estimated for environmental benefits for electricity from biogas (Note A-4 examples). Statute allows these values to be recognized in electric power generation. Thus we propose that environmental benefits, including greenhouse gas and VOC abatement, be reflected by a credit, applied where biogas capture mitigates emissions to the atmosphere[8]. This credit is provisionally termed a Greenhouse Environmental Credit, ("GEC") assigned each kilowatt generated from biogas[9]. This would value environmental benefits in accordance with statute, with emphasis to the severalfold greenhouse gas abatement compared with other renewables.

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[7]Federal section 29 tax credits effectively provided about 1 cent/kWh to electricity from most LFG projects under binding contract by the end of 1995. Credits will no longer be available for new projects.

[8] Applying for example, to manures, landfills and certain sewage and food processing wastes. Excluded from credit, however, would be de novo fermentations of non-waste harvested feedstocks "for biogas"(as for example grasses grown especially for conversion to biogas). These provide no added greenhouse gas mitigation beyond that available from other renewables, thus merit no additional credit.

[9] This proposal assumes use of a credit-based approach as favored by the CPUC. A surcharge approach could also be workable and we do not wish to imply that it should be precluded.

Of course, any valuation such as via the proposed GEC raises questions. The principal question is, what total per-kWh value of a renewable, as related to other benefits, should be assigned to global climate benefits? Monetary valuations of "externalities" are inherently imprecise, having subjective or "value judgment" components[10]. However almost all arguments in favor of renewables emphasize the same basic components--global change, regional/local air pollution, sustainability, and domestic/local production. If equal weighting were to be assigned to each factor, a ninefold higher climate change benefit should translate to a threefold higher REC value for electricity from biogas compared to other renewables. Even recognizing that some control will take place for certain wastes, additional monetary incentives for any additional biogas used for energy would achieve much additional control. Substantial value for the GEC is thus justified by the additional offset. Here we propose the GEC for electricity from biogas be set equal the REC for other renewables. This would reflect a premium of 100%, as biogas would receive a total of 2 REC's per kWh generated from it.

Certainly, value of greenhouse gas abatement may be significant, up to several cents/kWh for electricity from biogas (Note A-4). The potential value of the biogas electricity premium based on CO_2 abatement is also addressed in EPA, 1993 which arrives at the same order of value. Both greenhouse gas abatement cost, and cost-effectiveness calculation bases are discussed in note A-7. The calculation basis proposed here is (1) Equivalent CO_2 abatement calculated by methods of the federal Title 1605 [b] reporting program (2) "Reference" electrical generation efficiency stipulated, (3) incremental cost assigned to abatement is that of the added GEC (or REC), that is assignable to climate benefit. On this basis, the cost of carbon abatement at a REC = $.02 is $14/ton CO_2 carbon, i.e., $3.90/ton CO_2, and at a REC value of 0.03 the cost is $ 21/ton CO_2 carbon, i.e., $5.80/ton CO_2.

We also suggest a cost-effectiveness standard for greenhouse gas abatement using the GEC. A limit could be set such that abatement cost does not exceed $25/US ton carbon or $ 6.80 /US ton CO_2 equivalent, calculated as above, adjusted as necessary for inflation. The GEC could apply whenever cost for greenhouse gas abatement falls below this limit. If carbon abatement costs are above this limit, the REC alone could apply or other adjustments made in application of the GEC[11]. However it is unlikely that this cost limit would be exceeded at anticipated values for the REC.

h. Issues with the GEC

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[10] However values can certainly be established by various criteria--see CEC staff papers in connection with docket 93-ER-94 on valuation of air quality benefits

[11] For example, cap or reduce GEC value (in terms of its REC equivalent) such that cost standard is met over specified intervals. This cap could also apply to situations where less incentive is needed to recover biogas, or to address other problems, as from variable REC monetary value. See also response to question C-5.

This assignment of increased REC (i. e., via the GEC) to reflect the climate and pollutant benefit associated with biogas use raises several other issues and questions. These include (1) administration, (2) that biogas kilowatts would presumably receive more payment per kWh than is received by other renewables, (3) that biogas kilowatts could adversely affect (or "squeeze out") desirable use of other renewables, (4) rather than assigning electricity from biogas what is in effect a higher REC value per kilowatt, why not "band" biogas, giving it a setaside, or minimum use requirement in the portfolio as proposed for certain other renewables? and (5) is this approach fair to ratepayers? We discuss each of these**:**

For (1)**:** Administration could certainly become complex if GEC's were to be handled independently from REC's. As implied above, we suggest the administrative complexities with the GEC for biogas be minimized by tying it to the REC and handling it exactly as REC for convenience. This should minimize incremental administrative work.

In the future, however, the GEC might be treated separately and traded independently from the REC. An important feature of greenhouse gas abatement is that it has the same value to the world's environment regardless of where in the world the greenhouse gas abatement occurs. Thus such credits might easily have value and be traded nationally, or even internationally.

(2) The resultant higher sales price likely for electricity from biogas via a Greenhouse Environmental Credit is, in any event, paralleled by the treatment already requested for solid fuel biomass, as well as for presently-higher-cost technologies making the transition into commercial application:

Solid fuel biomass is requested in both AWEA and IEP proposals to be "banded", i.e. to receive a setaside such that most existing solid fuel biomass plant remains or is brought online. (This is also embodied in the legislative approach of AB1202.) It is expected by IEP and AWEA that this will result in higher costs for solid-biomass-fueled power. For solid fuel biomass the justifications listed by AWEA for higher cost and keeping solid-fuel-biomass plants online include (a) waste diversion from landfills (b) prevention of open agricultural burning and (c) forest management benefits. (a bringing indirectly, and b bringing directly, environmental benefits that should be valued consistent with utilities code [sect 701.1 (c)] above) In the case of electricity from landfill and other biogas, the environmental benefits valued consistent with utilities code sect 701.1 (c) are instead simply the increased mitigation of climate active gases--and VOC's in addition (again refer to Note A-4).

In the CEC Energy Technology Development Division (CEC/ETD) staff proposal, higher purchase prices are also advocated for technologies transitioning into early commercial application**;** the higher sale prices would obviously help these toward commercialization. This is another case of higher prices for certain renewable categories, for purposes considered beneficial.

(3) We propose that biogas to electricity should be able to increase without adversely affecting or diminishing use of other renewables. The climate active gas mitigation with electricity from biogas is public good of high importance (internationally, inasmuch as climate change is an international issue). It is directly relevant to, and offsets, adverse global climate impacts of the electric utility sector. There appears no reason that increased biogas use, as justified by added climate benefits, should result in diminished use of other renewables with their corresponding benefits. Providing greenhouse gas abatement meets stated cost-effectiveness criteria, it is proposed here that total allocated REC's should be increased by whatever amount is necessary to accommodate all electricity from biogas (the biogas REC total including the GEC equivalent). In any case, REC's for, and total production of, other renewably based electricity should remain the same as they would be absent electricity from biogas. This treatment can assure that other renewably based generation is not affected.

(4) For solid-fuel biomass, generation "banding" proposed by other organizations is slightly less than needed to bring online the totality of operating, shutdown and recent BRPU auction-winning solid-fueled plant capacity. That capacity is well-defined. Capacity is also constrained in ways (fuel supply, costs) such that costs might escalate relatively rapidly with any added capacity and power production increments above the "band". In the case of biogas, fractional use for electricity is very low. Potential for additional electricity from biogas may be severalfold the existing level (refer to Note A-6).

A continuous spectrum of costs is expected for electricity from landfills and other biogas sources, depending on scale and other factors. Incremental additional generation (and greenhouse gas abatement) can be expected to respond elastically to price. "Banding" appears too rigid an approach to address this situation. Uncertainty attends estimates, but the degree to which price might affect generation of electricity and consequent methane (greenhouse gas) abatement with landfill gas is suggested by the figures provided in analyses of EPA (1993). When buyback rates rise from $0.04 to $0.06/kWh, (at a favorable [optimistic] project discount rate assumed in EPA, 1993, at 8%), the resulting electric generation and methane abatement, and equivalent CO_2 abatement more than quintuple for the U.S. In EPA, 1993, presuming a buyback rate of $0.06/kWh, U.S. landfill methane abatement rises in the year 2000 to 8.2 million metric tons, equivalent (at official IPCC values) to over 200 million U.S. tons CO_2 abated. It is worth noting that greenhouse gas abatement equivalent to 200 million U.S. tons/year of CO_2 constitutes offset to roughly 10 percent of fossil CO_2 emissions of the U.S. electric utility sector annually--and this is for landfill biogas alone. It is also worth noting that electricity from manure biogas has a wider and somewhat higher spectrum of costs (EPA, 1993, Sharp, 1996); manure methane is estimated to have total climate change impact about 30-50% that of landfill gas (see data of EPA, 1993, Whittier, 1994). It would be expected to have similarly significant price response in terms of power generation and greenhouse gas abatement.

In any event, whatever incremental electricity from biogas does come online in response to price will result in further GHG and VOC offsets, thus public benefit. The allocation of two RECs per biogas kilowatt--via GEC's--lets this resource and its corresponding benefit or corresponding "public good" expand elastically to the extent that it can in response to price. The biogas electricity price premium can be justified on cost/benefit criteria developed on the basis of costs for abating emissions (Note A-4).

At the same time the cost obligation with the GEC approach is not open-ended: First, tying the GEC to the REC determines GEC value in turn by the same competitive factors determining REC value in an active market. Secondly, the eligible biogas-from-waste resource constrains maximum generation to less than 3% of California electricity (likely, about 2%). Finally, as noted, a cost-effectiveness standard can be applied in terms of an upper limit to greenhouse gas abatement cost. It must be emphasized that the overall intent is to apply the GEC to mitigate climate impacts, limiting GEC scope and application to situations where it provides the most cost-effective abatement of climate active (and pollutant) biogas emissions.

(5) A general, certainly major issue with monetization of renewables' environmental, and other benefits--that of fairness**:** Is it fair to charge premium costs for landfill and other biogas and other renewably based power which are passed through to ratepayers?

The utility sector, and ultimately ratepayers, bear responsibility for greenhouse gas emissions. Thus electricity user support of renewable and biogas-based power as discussed here appears as fair as any mechanism to offset environmental and other impacts of electric power production. As noted earlier, one advantage of electricity from biogas for ratepayers is that it is among the most "greenhouse-cost-effective" of CO_2 emission offsets, per kWh. Even at twice the REC subsidy, the ratepayer still gets much cheaper greenhouse gas abatement than with other technologies.

A comment here is that this proposal supports the CEC-ETD staff approach to provide a higher revenue tier for technologies in earlier stages of commercialization. Electricity from manure biogas has significant potential but remains in early development with probably less than 2MWe nationwide, and likely 1MWe or less in California. Manure biogas in particular is a present major source of greenhouse methane in the U.S. A band in which electricity from manure biogas receives higher revenue--possibly by additional RECs beyond the extra from the GEC is appropriate.

i. GEC operation

An RPS standard could require that (for example) 10% of total California electricity generation could be met by renewables, aside from biogas. If biogas eligible for the GEC were to provide an additional 1% of total California electricity generation then the RPS would expand to accommodate biogas-based generation. The RPS would require purchase of power or RECs equal to 12% of generation, i.e., the 10% of other renewables + 2% representing the biogas REC + GEC. (In meeting the portfolio standard biogas based power usually would via the GEC + REC, either count twice, or give rise to two REC's.) This renewables (or equivalent renewable credit) obligation would accrue pro rata to all UDCs (or whatever entities must meet the renewable portfolio obligation according to portfolio standards).

Allocation of 2 REC's per biogas kilowatt via the GEC as opposed to one per other renewable kilowatt, could operate as in the following simplified examples.

1. If (as another example) the RPS were for 15% renewable energy or credits in the mix, the REC credit need would actually be met by purchase of 10% other qualifying renewables plus 2.5% of the electricity from biogas (thus, 5% of power credited from biogas).

2. If a customer in a bilateral agreement were to purchase 100% of electricity supply needs from biogas, and a GEC = 1.0 REC, then renewable energy credits would amount to 200% of those kilowatts. In an active market characterized by many buyers and sellers, it would be expected that extra REC's would accrue value which could return to the customer (in a manner similar to other commercial rebates), and that market mechanisms would exist or develop to realize the REC's value for the power customer to the extent desired.

As discussed the intent with the GEC to obtain added, highly cost-effective greenhouse gas mitigation, but without affecting other renewables' uses. To this end the purchase requirement would be adjusted, annually, by adding to it all REC's (including from GEC's) resulting from electricity from biogas. This would be done as soon as the biogas-fueled generation data were available from the previous years' operation.

j. Concluding Note

In other aspects this biogas and climate active gas proposal would generally conform or be subordinate to, terms of other proposals**:** the proposals include--but are not limited to--that put forth by the California Energy Commission staff (tier approach to foster renewables in early stages of development) and the joint proposal of the American Wind Energy Association/California Biomass Energy Alliance/Geothermal Energy Association and the proposal of the Independent Energy Producers Association. This proposal is intended to be a suitable adjunct to as wide a range of proposals as possible. In cases where other proposals differ, this group is neutral where it feels differing approaches have merit. This group may later state preferences where these exist.

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l. Appendix A--Notes to Overview

Note A-1. Greenhouse Gas/Ozone Loss/Air Pollution Issues:

The generation of power using biogas helps overcome the following problems:

Global warming: Atmospheric emissions of U. S. landfill and other biogas are major factors in global warming, simply because of the enormous quantity of waste and manure, and the climate change potency of methane. In scientific terms, U. S. landfill methane, alone, adds a roughly 1% increment to the total annual increase in radiative forcing due to buildup of all greenhouse gases in the atmosphere (see Augenstein, 1992). To simplify terms, this means it can be considered responsible for about 1% of the "greenhouse effect". U. S. animal manure impacts from methane emission, are about 30-50% of those from landfill gas (see information in EPA, 1993, Whittier et al 1994).

Stratospheric ozone depletion Methane--including that from biogas--adds significantly to the recent atmospheric methane buildup. That atmospheric methane buildup has given rise to stratospheric changes which have resulted in turn in the recent sharp losses in polar stratospheric ozone, i. e., the "ozone hole". Stratospheric ozone depletion and the "ozone hole" are now international concerns. (Blake, 1994).

Local air pollution. Landfill and other biogas contains organic pollutants. For landfill gas, these pollutants are the focus of federal, state (California) and local air district rules.

While analyses can easily become extremely detailed, it is possible to simply summarize:

As noted in the text, generation of one kWh from biogas can effectively offset the CO_2 emissions from the order of 10kWh of fossil fueled power. (Capture of one molecule of methane as opposed to emission, offsets 9 CO. Since "swing fuels providing extra incremental power over baseload are nearly entirely fossil, an additional fossil CO_2 or more is displaced by any renewable) Consequently, generation of 1-2% of total electric power with landfill and other biogas, which is the potential in a typical utility service area or state such as California, has "greenhouse effectiveness" equivalent to reducing fossil carbon dioxide emissions by that generation 10% or even more.

The abatement of other gas components (VOC's) has substantial further value as does addressing stratospheric ozone depletion.

Electricity production from biogas can help address all of the stated problems. This is very-well-recognized by electric utilities themselves, utility trade organizations, and government agencies (at all levels). As detailed later below, factors 1 and 2 (climate change) drive U.S. electric utility conformance with the climate challenge; EPA and Department of Energy programs promote biogas energy uses for these benefits.

Note A-2. Electric Utilities' Positions

The Edison Electric Institute (EEI), the Electric Power Research Institute (EPRI), and numerous individual utilities are taking positions to support or facilitate member utilities' use of landfill gas power (nearly all purchased from IPP's).

EEI (investor owned utilities)--≈ 70% of the investor-owned utilities (in terms of EEI member electric generating capacity) are signatories to the climate challenge. EEI is strongly encouraging all member utilities which use landfill gas electricity take credit for greenhouse gas offsets to the maximum extent possible, reporting methane abatement fully under the DOE 1605 (b) voluntary program to report greenhouse gas abatement.

EPRI supports landfill gas electricity through studies, (see EPRI 1992 reference, this document) and dissemination of information to member utilities. EPRI also supports renewables and greenhouse gas abatement research.

Individual Utilities have long taken interest in electricity from biogas.

Note A-3. Government Agencies' Positions

International, Federal, State and Local agencies endorse objectives met by landfill gas electricity.

International initiatives include the Rio conference, and a number of related international efforts toward renewable energy and greenhouse gas abatement. Other efforts are exemplified by the International Energy Agency (landfill gas expert working group supporting energy uses) and the Intergovernmental Panel on Climate Change (a major working group tracks methane from wastes).

Federal initiatives include the Climate Change Action Plan (CCAP) and Clean Air Act (CAA), On LFG:

-Under CCAP, USEPA is facilitating landfill gas use via the Landfill Methane Outreach Program (Climate Change Action Plan item # 34) as well as the (related) AgStar program for use of methane from manures (Climate Change Action Plan item # 38).

-Under CCAP, also, the DOE is managing RD&D on methane recovery from landfills (Climate Change Action Item # 37)

-The DOE is also conducting the 1605 (b) voluntary program by which participants report greenhouse gas emission abatement. Nearly all utilities report greenhouse gas offsets (in terms of official CO_2 equivalents above) associated with landfill gas power which they purchase.

State (California) Initiatives include the California Environmental Quality Act (CEQA) those of the California Energy Commission (CEC), California Air Resources Board (CARB) and Waste Board (CIWMB).

Local initiatives include rules in California Air districts.

Note A-4. Economic Factors--Valuing Emission Abatement with Electricity from Biogas.

What is the greenhouse gas abatement value? The valuations assigned to GHG abatement by states' PUC's were stated in earlier text. Many U. S. electric utilities are also presently addressing (or willing to address) global warming by projects to abate or offset fossil CO_2 carbon emissions. This is sometimes due to the PUC guidelines (examples: MA, WI, NY) but has often been voluntary. Some U.S. utilities have been willing to consider projects to accomplish GHG abatement at costs up to $10-20/ton fossil CO_2 carbon abated (or $2.75-5.50/ton fossil CO_2, in the U.S. European abatement and offset processes over twice these stated U. S. costs are under way). On the basis of lower cost U. S. GHG abatement, and knowing generation heat rates and the greenhouse potency of methane, valuations for methane abatement can be calculated. Example calculations summarized in Table 2 (next) result in GHG abatement values of $ 0.014 to $ 0.075/kWh for electricity from biogas.

What is the value of VOC abatement? California air rules typically entail cost (thus implied value) of $1.00 to $2.50 per pound of pollutant destroyed. Worth of VOC (air pollutant) abatement be calculated assuming values for landfill gas VOC content and heat rate. These calculations (also in Table 2) show values for air pollutant abatement that might range between 0.28 and 2.1 cents/kWh.

The total of these benefits' calculated value--per kWh generated--is $ 0.017 to 0.096/kWh.
All calculations with their basis are presented in Table 2 (next page).

Note A-5. "Public Good" from Biogas-to-Electricity Emission Abatement.

Example calculated values of methane and VOC emission abatement (above) ranged from \$0.017-0.096/kWh. These calculations indicate "public good" which accrues with the use of electricity from biogas. Several considerations arise in the evaluation of the degree of "public good"**:**

Some degree of methane and VOC abatement (see further discussion) will occur with LFG because of regulations anyhow, even without conversion to electricity. However the "public good" value per kWh will still exist for nearly all biogas conversion to electricity**.**

TABLE 2 ENVIRONMENTAL BENEFIT (EXTERNALITY) VALUATIONS IN SUPPORT OF BIOGAS-FUELED ELECTRIC POWER GENERATION

I. GREENHOUSE GAS (GHG) MITIGATION potential valuations: Range: 1.4 to 7.5 cents/kWh with assumptions below

VALUATION OF FOSSIL CO_2 CARBON ABATEMENT		Assumed mol ratio CH_4/CO_2 greenhouse potency	energy credit, \$/MCF CH_4 used (or \$/10^6 Btu)	Generation heat rate, Btu/kWh	Calculated greenhouse gas mitigation credit, cents/kWh
\$/ton CO2 carbon	**\$/ton CO2**				
\$ 10	\$ 2.75	9/1 (U. S. DOE 1605 b official value, 1996)	\$ 1.42	10,000	1.42 cents/kWh
\$ 10	\$ 2.75	9/1 (U. S. DOE 1605 b)	\$ 1.42	15,000	2.13
\$ 20	\$ 5.50	9/1 (U. S. DOE 1605 b)	\$ 2.86	10.000	2.86
\$ 20	\$ 5.50	9/1 (U. S. DOE 1605 b)	\$ 2.86	15,000	4.27
\$ 10	\$ 2.75	16/1 (Rodhe, 1990, Augenstein, 1990, 1992)	\$ 2.51	10,000	2.51_
\$ 10	\$ 2.75	16/1 (Rodhe, Augenstein,)	\$ 2.51	15,000	3.76s
\$ 20	\$ 5.50	16/1 (Rodhe, Augenstein,)	\$ 5.02	15,000	7.5 cents/kWh

II VOC EMISSION MITIGATION potential valuation: Range 0.28 to 2.1 cents /kWh with assumptions below

Valuation of VOC abatement, dollars/lb. VOC's mitigated	Assumed weight ratio of VOC's to biogas (ave M. W . 28)	energy credit, per \$/MCF or 10^6 Btu	Generation heat rate, Btu/kWh	Calculated VOC mitigation or "offset" credit, cents/kWh
\$ 1.00	0.0025 (= 0.25%)	\$ 0.28	10,000	0.28 cents
\$ 1.00	0.0025 (= 0.25%)	\$ 0.28	15,000	0.42 cents
\$ 1.00	0.005 (= 0.5%)	\$ 0.56	15.000	0.84 cents
2.50 (Typical Calif. cost, CARB)	0.0025 (= 0.25%)	\$ 0.70	10,000	0.70 cents
\$ 2.50 """"	0.0025 (= 0.25%)	\$ 0.70	15.000	1.05 cents
\$ 2.50	0.005 (= 0.5%)	\$ 1.40	15,000	2.1 cents

Total potential credit range, cents/ kWh by calculations above (GHG = 1.42 to 7.5) + (VOC = 0.28 to 2.1) = 1.7 to 9.6 cents/kWh

cont. from page 15

-Even with gas control regulations, methane and air pollutant mitigation is accomplished automatically by electricity generation, offsetting costs of abatement by other routes--thus there is still public good in terms of cost saving to the public (which in the end, directly or indirectly, bears nearly all abatement cost). In addition, regulations, even when they apply, are inefficient at abating emissions for several reasons.

(a) efficiency of "control only" landfill gas recovery systems without further measures to maximize gas recovery is only 50-90%

(b) there is inefficiency of rule driven biogas recovery for other technical reasons, e.g.**:**

i. Federal and California rules really address only VOC's in landfill gas. There exists no U.S. or California statutory authority to control methane emissions to the atmosphere per se (and, methane control is what offsets utility sector greenhouse CO_2). For landfill gas, VOC levels are low enough so that sites with potential to 5MWe or more (thus most sites) can escape methane emission control[12].

ii Final federal clean air act rules exempt landfills below 2.7 million U. S. tons a priori from control; thus landfills below 2.7 million tons, containing about 40-50% of all U. S. waste will escape control unless other mechanisms can ensure recovery.

iii For California, a landfill surface concentration standard to drive control is sufficiently imprecise (i. e. for fugitive emission assessment) that large fractions (> half) of landfill gas may occur as well.[13]

iv. Manures (major sources of greenhouse gases) are exempt from gaseous emission controls

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[12] This is supported in letter communication and documentation of Don Augenstein to Mark Najarian, then head of EPA clean air act implementation, March 21, 1994. Supportive information is published as well in the March 1994 proceedings (Augenstein, D. "Landfill Gas Control, Landfill Gas Regulations and Climate Change--some Practical Considerations") and March 1996 (S. Hill paper) proceedings of the Landfill Gas Division of the Solid Waste Association of North America.

[13] See letter of Dr. Stanley Zison to James Behrman, Toxic Program Support Section, California Air Resources board, dated May 15, 1990. Also letters and documentation of Don Augenstein to William Schuldt, Yolo-Solano Air District, and Renaldo Crooks, California Air Resources Board, December 12, 1994. Both these communications make the point that measured surface gas concentration is far more the correlate of meteorology than fugitive emissions

However with electric revenue and profits at stake, landfill and other biogas can be expected to be "scavenged" to maximize electric power generation from the biogas at given sites (this is amply substantiated by experience with landfill gas fueled electricity production under California's SO-4 contracts). Measurements, where carried out, have shown this "scavenging" to substantially decrease CH_4/VOC emission (Zison, 1990). Thus biogas use for electric generation increases public good from emission abatement.

All of the public good arguments are explicitly or implicitly reflected in federal and California programs and statutes. However the gas control (and thus public good) resulting from present regulation is at best partial. Additionally, economics for most biogas use are presently too poor to support current EPA and DOE biogas energy use initiatives that are important parts of the Climate Change Action Plan. For example the economics for gas use are presently poor enough that only about 20-25% of California landfill gas finds beneficial energy use. The balance is wasted, in large part by atmospheric emission.

Promotion of environmental benefits as discussed above, via GEC's and increased revenue, could help significantly toward offset of adverse effects of climate active gases for which the utility sector bears responsibility. These climate active gases are also of major federal and international concern. It also values local air quality benefits according to statute. In summary a sufficient sale price for electricity from biogas in the restructuring process via the GEC addresses these problems, and maximizes public good in terms of greenhouse gas and other emission abatement.

Note A-6. Landfill gas and manure biogas electric potential in California

California landfill gas electricity potential is estimated by prorating the national potential stated by EPRI or U.S. EPA (roughly 5000-7000MWe) according to population. This is valid given per-capita waste disposal and methane generation that is similar across the U.S.

For manure methane, in the reference of Whittier et. al., the gross potential in California is cited as 20 billion cubic feet per annum. Assuming 25-50% of this can be economically captured for electricity the electric potential from manure in California, at heat rate of 12,000 Btu/kWh, is about 50-100MWe.

Note A-7 Calculating "equivalent CO2 offsets" from biogas use.

The global warming potential (GWP) mitigated, or "CO_2 offset" from energy use of methane is the key benefit of the GEC. This CO_2 offset can be expressed in a relatively simple equation:

$MCO_2 = F \times CO_{2eq}$.

Where MCO_2 = Equivalent carbon dioxide mitigated (the "CO2" offset)

F = Fraction equivalent to (methane emission mitigated/methane used for energy).

CO_{2eq} is the carbon dioxide equivalent of methane (weight or volume--see below)

In many situations (as with methane from lagoons) F approaches 1. The value of F = 1 means that methane captured for energy reduces an equal amount of methane emission to the atmosphere. In the case of landfills, values for F depend on site factors. For large landfills, whose control could be presumed in any case, added mitigation (from methane "scavenging") with energy use may average closer to 25%; for smaller landfills the mitigation may be 50% and for smallest, without control, the mitigation approaches (i. e., F = 1.0) Values for F averaged over all landfills may be around 50%, (but it is noted that site-specific analytical determinations to enable exact values for F have been scarce and are technically demanding). Reasons for landfill control inefficiencies (thus that F is likely ≥ 0.5 overall) were discussed in note A-5.

Lower values for F result in lower values for MCO_2. However the CO_2 equivalence of methane by IPCC rules is conservatively low[14] and higher potencies for methane are readily substantiated by straightforward calculations (evaluating radiative forcing over shorter time spans):

Source of calculation	Calculated CO_{2eq} of methane, weight/weight	Calculated $CO_{2\ eq}$ of methane, vol/vol
IPCC working value	24.5	9
Augenstein, 1992	41	15
"Instant" potency	68	25

Thus F can be below 1, but higher values of CO_{2eq} can equally well apply. These have opposing, canceling effects on MCO_2. A reasonable approach is suggested here to be use of conservative (low) IPCC values for CO_2 with assumption of complete abatement. These same rules (assumptions) are already applied in the U. S. Department of Energy 1605 (b) program for voluntary reporting of greenhouse gas abatement.

[14]IPCC integrates methane's radiative "greenhouse" forcing over 100 years. Augenstein (1992) assumes a timespan of 40 years. Methane, molecule for molecule, is about 25 times as potent as CO2

Another issue in calculating greenhouse gas abatement per kWh of electricity from biogas is thermal efficiency, which relates kWh to CO_{2eq} destroyed. However heat rate can vary; onsite measurements of heat rate can be difficult and uncertain. To avoid the intricacies of determining process-specific heat rates it is suggested that a heat rate of 10,000 Btu/kWh be stipulated for any CO_2 eq determination. This probably reflects well the heat rate that will obtain for the near term (present rates are closer to 12,000 Btu/kWh). As a lower number of Btu/kWh corresponds to lower CO_{2eq}, this stipulated efficiency is conservative in the CO2 mitigation it projects. Also, by adopting this fixed thermal efficiency in calculating CO_{2eq}, processes that are in actuality less efficient are penalized and efficient ones rewarded in the proposed approach (the desirable result)

In calculating cost-effectiveness of greenhouse gas abatement a further "accounting" issue is cost to attribute to abatement-i. e., should the cost be the GEC per unit MCO_2--or some other value? All REC costs (perhaps 2REC/kWh) could--conceivably--be deemed for (or charged to) greenhouse gas abatement. However biogas use gives not only greenhouse gas abatement but the other benefits in common with all renewables. For electricity from biogas, benefits aside from greenhouse gas abatement include (a) addressing stratospheric ozone depletion (b) domestic production (c) local economic benefits (d) sustainability, and (e) the abatement, for all biogas, of a very considerable degree of local air pollutant emission. Even though valuations are subjective, these justify at least one of the two RECs by the same reasoning applying to other renewables, leaving the other REC (from the GEC) as the incremental cost assignable to the greenhouse gas abatement.

Altogether, the above presents the basis for greenhouse gas abatement cost as incremental cost of the GEC, assigned to the fossil CO2 carbon offset as determined above. This is the basis selected for this proposal, and presented in the overview.

3. Implementation Questions

a. What is the Obligation?

a.1 How is "renewables generation" defined for purposes of qualifying for tradeable "renewables energy credits" (REC's) under this proposed program? Do existing and utility-owned renewable-resource generation qualify for Renewable Energy Credits?

Renewables generation is defined on a kWh basis, except that biogas kilowatts are given Greenhouse Environmental Credit in addition to the Renewable Energy Credit (REC) of other renewables. See AWEA for more detailed definitions of renewables. In addition to AWEA's definition, hydro might be included, but factors need to be addressed as noted in a.8

See AWEA--existing utility-owned renewables are included

a.2 *What are renewable energy credits? How do they relate to energy portfolio management?*

See AWEA or IEP. RECs represent a value assigned to one unit of energy production, one credit per kWh of production except for biogas which receives a greenhouse emission credit (provisionally, equal to another REC) as well as a renewable energy credit in this proposal.

A renewables purchase obligation would require each UDC (or any entity) selling electricity to retail (end-use) customers to be responsible for purchase and distribution of a <u>pro</u> <u>rata</u> share, constant statewide, of renewable power <u>or</u> corresponding RECs for renewable power. The entity's purchase obligation for renewable power (or equivalent REC's) is expressed as a percentage of total retail sales of electricity. The purchase obligation could include as well a <u>pro</u> <u>rata</u> share of banded solid fuel biomass, and pre-commercial technologies (including manure biogas) as in proposals of others including the present proposal, IEP, the CEC or AWEA.

a.3 *How is a diversity of renewables encouraged?*

Electricity from biogas is effectively favored. However it is proposed that its allocation be expanded so that all electricity from biogas is accommodated to maximize cost-effective climate benefits, <u>without</u> reducing the allocation for other renewables . By expanding the REC/GEC allocation in this way, the generation from, and diversity of, renewables would be essentially unchanged from that would otherwise exist absent biogas to electricity. Otherwise see IEP or AWEA *a.4 Are currently high-cost technologies or pre-commercial technologies fostered by this program?*

Yes. Much electricity from biogas is high cost (in terms of electric power cost alone, without considering climate benefit). This proposal facilitates its use by factoring in the climate benefits through the GEC.

This proposal additionally concurs with AWEA and IEP on banding of solid-fuel biomass facilities. It also agrees with the CEC staff proposal proposing the tier approach. In the CEC tier approach, technologies starting their transition to full commercial deployment receive higher revenue than renewables developed to greater degrees of commercial deployment (like wind, geothermal, etc.). The higher revenue is achieved through mechanisms such as increased REC's per unit of power generated, or perhaps other mechanisms (to be more fully developed).

A specific issue is that manure biogas is sufficiently far from wide commercial deployment so that it should be placed in a higher revenue tier, possibly by more than one GEC or REC per kWh. If a limited amount of generation (say, 10MWe) is in a higher revenue tier to assist the development to "full-commercial" status it should not be subject to the cost-effectiveness standard.

a.5 How is renewable self-generation handled? Is self-generated renewable energy eligible for Renewable Energy Credits (REC's) or for other means of support?

Renewable self-generation, as with grid-delivered, does provide the benefits of renewables. However renewable self-generation already presumably nets a premium in "backing out" higher cost retail electricity-and, perhaps, any competition transition charge. It is also harder to track, presenting administrative difficulty. It is in addition already economical (or it would presumably not be done). On all these bases it is suggested that renewable biogas self-generation might be excluded or perhaps (though it would be administratively intricate) should receive lesser credit perhaps only the REC per kWh.

a.6 How are hybrid fossil-fuel/renewable facilities handled?

The REC's assigned per kWh of output should represent, as well as possible, the fraction fueled by, thus attributable to, the renewable resource. Thus if the renewable fuel thermal energy fraction is 75% each kWh would represent 0.75 REC. In the case of biogas the GEC's would be prorated as well on biogas heating value. (This issue is quite pertinent because of cofiring progress made and applied both with landfill gas and wood/fossil. However the approach may also become administratively complex during fossil/biomass fueling ratio changes, etc.)

a.7 Does out-of-state generation qualify for REC's? Is it desirable or necessary to protect in-state California renewable energy generators from out-of-state competition? Is it possible?

The treatment of GEC's and REC's for biogas is as with REC's for other renewables--out of state generation would appear eligible under the commerce clause, and restrictions would not appear possible.

a.8 If hydro is included, how are practical issues associated with hydropower handled?

Hydro may very likely not be included. (AWEA or IEP provide more discussion). However if hydro is included as advocated in some proposals then it may be necessary to separate its band from other renewables to avoid complexities and untoward effects of year-to-year hydro variation on levels of other renewables' use. Cost equity needs somehow to be achieved between hydro and other renewables, particularly so that low-cost hydro does not provide an avenue to "back out" use of other renewables. To avoid this and yet other complexities it may also be most desirable to restrict eligible hydro to environmentally mitigated, or new (online since (say) 1/95 (SMUD approach). Hydro advocates need to offer some better solutions if hydro is to be accepted.

a.9 How are utility-owned distributed renewables handled? Does the proposal permit or prohibit REC's being awarded to distributed renewable power not sold through the power exchange? How does the proposal guard against self-dealing or cross-subsidization? For example does the proposal permit REC's to accrue to applications that may involve the cross-subsidization of generation with T&D savings, or vice-versa?

AWEA or IEP approaches are valid for handling of utility-owned distributed renewables.

There is likely T&D saving with electricity from landfill gas and digester gas. Saving accrues from the fact that these are nearly all adjacent to population centers that use the electricity. This is likely a "bonus" that will to some extent improve overall system efficiency and lower cost. How much of a bonus it comprises cannot be estimated at this time.

a.10 What is the level of the requirement? How does this level relate to the level of renewables from 1990 to the present? Does the level of the requirement increase over time, and if so, at what rate?

A base level of 10% renewably based electricity as of the start date is suggested (identical to AWEA proposal), <u>plus</u> however much electricity may be generated from biogas. A level of 10% is slightly below the maximum renewables output that was achieved (in 1993--see AWEA, citing statistics provided by CEC) and should result in adequate competition. An increase of 0.2% per year as the renewable fraction of the total generation portfolio is suggested (as with AWEA). However the annual increase rate would be set under terms of any proposal to which this proposal is an adjunct.

a.11 Describe how, if at all, the compliance obligation adjusts during a transition period.

The compliance obligation may need legislation developed to bring utilities not under CPUC jurisdiction under the obligation. See answer to next question.

a.12 Does the proposal provide a uniform requirement for all electric providers, including utilities, on a statewide basis?

It is anticipated here that initially, all utilities/UDC's subject to the jurisdiction of the CPUC would purchase power or REC's sufficient to attain the renewables requirement. Eventually the obligation would apply to all entities selling power to end-users. See also a. 2. Legislation may be required to bring the entities other than IOU's in.

a.13 What is the time-horizon for the program?

(Note: Financing of new renewables facilities, which increases competition, may be contingent on an expectation that a market for renewable power will exist for an extended period of time)

Starting as soon as possible. The portfolio requirement should at minimum continue for a long enough period for renewable projects to obtain financing, at least exceeding 10 years. We would propose that it continue indefinitely, to the extent a credit continues to be justified by environmental and conservation benefits, and so long as renewably-based generation costs are in excess of fossil-based.

a.14 Is the requirement established on a percentage of megawatts or percentage of megawatt hours basis?

Megawatt hours, since benefits are proportional to megawatt-hours generated. As Greenhouse Environmental Credits are envisioned an added GEC + REC purchase obligation would be as a pro rata share of whatever electricity megawatts are generated from biogas.

a.15 Does the proposal establish floors for certain technology types? What is the rationale for a technology floor, if proposed?

Floors are advocated here for solid fuel biomass, and pre-commercial technologies. The floor for solid-fuel biomass assures continuation of desirable levels; the floor for the precommercial technologies helps their development to commercial status. In the case of biogas, a GEC is proposed in addition to an REC, with initial effect that a kWh receives an REC twice that for other technologies. This treatment for biogas has effects similar to a floor, but greater flexibility in promoting use and environmental benefits and is based on the additional climate benefits.

b. Where is the obligation to comply?

b.1 On whom is the requirement applied? Is the requirement applied only to entities under the CPUC's jurisdiction, or is it applied statewide?

It seems most practical that the requirement should be imposed on all utilities or other entities selling electricity at retail (i. e. to end users), including municipally owned and others not now regulated. Legislation is required to accomplish this.

b.2 Are regulated retail providers treated similarly to unregulated retail providers? If not, what are the differences? What is the status of entities not under CPUC jurisdiction in this program?

See AWEA, for discussion of treatment of regulated vs. unregulated retail providers. Entities not under CPUC jurisdiction will remain so until legislation enables their control.

b. 3 What is the penalty for non-compliance? Should this penalty be interpreted as a cost cap for this program?

Other proposals would fix the penalty in terms of REC shortfall, which would in turn effectively fix penalty for the GEC as well.

b.4 How is non-compliance determined? Who is responsible for determining non-compliance and for resolving disputes arising from such a determination?

See AWEA

b.5 What provisions and flexibility are there in compliance?

For administrative purposes and those of evaluating compliance, the GEC would be treated as its REC equivalent. Otherwise this question is not applicable (N.A.).

b.6 How does the program ensure that the policy and its costs are non-bypassable, such as the CTC or public goods surcharge?

See AWEA

c. How are Renewable Energy Credits Initially Allocated?

c.1 How are REC's generated from existing renewable facilities (QF's and utility-owned) initially allocated? What impact does the initial allocation have on whether a vigorous market for REC's, characterized by many buyers and sellers, forms?

See AWEA, c.1. This would apply to REC's resulting from GEC's as well.

c.2 What is the relationship of the allocation of the renewable energy credits and the CTC or Public Goods surcharge? Will REC's accrue to technologies, such as on- and off-grid renewables, in a way that would encourage customers to disconnect from the grid and avoid the CTC?

N.A.

c.3 If customers or ratepayers are initially allocated REC's, how are the credits administered?

N.A.

c.4 How would the proposed Renewable Energy Credit allocation affect negotiations to buy out existing QF contracts? Would it encourage or discourage such buyouts? Would it make them more or less cost-effective to ratepayers?

See AWEA.

c.5 How does the initial allocation deal with the possibility of windfall profits accruing to individual renewables generators, or types of generators?

The overall intent of this proposal is to maximize greenhouse gas abatement in the most cost-effective manner possible (and concurrently to limit "windfall" profits) To address "windfalls" and closely-related problems we suggest several measures:

Earlier ongoing projects should be "grandfathered" to their existing contracts as long as operational under contracts giving higher than market prices (market prices being the averaged statewide renewable sale prices to the pool, counting REC's). Projects while grandfathered receive no GEC's. After expiration of QF contracts the GEC could be set equal to half of an REC, to limit profits.

A related issue occurs in situations where costs are low, controls would be expected, and abatement would be reasonably expected through energy uses in any case. This might, for example, be the case with larger landfills (Note A-7 discusses this). One such specific case is that of landfills likely to require control by federal standards (based on prescribed VOC emission measurements). A size criterion--such as at 5 million tons--could apply where energy uses receive half, rather than one GEC per kWh. (The transition from applicability of one, to applicability of one half GEC/kWh should be staged such that the electric revenue does not dip, or rises slowly with this transition.)

To assure that the desired greenhouse gas abatement is maximized an additional measure is proposed:

-To receive the GEC, sufficient generating or other equipment be in place so all recoverable biogas is used or abated. This can be evidenced by biogas-fuel-limited operation of energy equipment[15] (This condition would provide strong incentive for efficient methane recovery and thus the greenhouse emission minimization which is the major corollary objective of electricity from biogas.)

Regarding any remaining "windfalls" occurring after these measures to limit them:

-We note that benefits accruing from the increased GEC would accrue largely to entities managing the wastes which generate methane. In cases of both municipal solid waste, and wastewater, management, revenue benefits of electricity generation return in very large part to the same base of ratepayers as pay for electric power.

c.6 Does the proposal potentially increase the value of utility owned renewable resources in a way that would encourage their divestiture? If so, how should ratepayer interests be addressed?

See AWEA

d. How is the Program Administered?

d.1 What agency certifies the REC's, and what does the certification process entail?

The CEC appears a likely candidate. Most relevant for this proposal, the agency certifying REC's would certify GEC's as well.

d.2 What mechanisms are proposed for trading of REC's? How do the trading mechanisms relate to the initial allocation of REC's?

See AWEA or other proposals. However a Greenhouse Emission Credit (GEC) is envisioned as trading at its equivalent REC value, and otherwise in exactly the same fashion as an REC.

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[15] Modular biogas-fueled IC engine capacity (or, soon, fuel cells) can be installed to meet this condition; alternatively other energy uses, or supplemental flares can assure minimum fugitive emission as well but energy uses with corresponding revenues are considered to provide maximum incentive for abatement.

d.3 What mechanisms are envisioned for program oversight and mid-course corrections?

N. A. This proposal is intended as an adjunct to other proposals in which those issues would be addressed. Adjustments to the GEC approach should be readily possible in conjunction to adjustments to the REC approach.

d.4 What agency monitors and enforces compliance with the program, and how is it carried out?

N. A. This proposal is intended as an adjunct to other proposals where such issues would be addressed. However, note that the agency would monitor the administration of electricity from biogas and assure that requirements associated with GEC's as well as REC's are met.

e. Cost Related Issues

e.1 What are the costs associated with the program, and who pays?

Two foreseeable cost components, are the GEC/REC cost, and the administrative cost. These are passed through to the ultimate electricity consumer. At this point, the REC value and the administrative costs are uncertain. However a "rough cut" is attempted here:

The GEC/kWh may end up (on average) in the neighborhood of $0.02/kWh. Given this the extra cost per biogas kWh would be (to the precision with which such estimates can be made) perhaps $ 0.04/kWh. The resulting GEC value of $0.02/kWh is incidentally, a low end valuation of the greenhouse gas abatement, and a low-end total for abatement of all emissions through biogas use (see Table 2, Note A-4)

To the extent that estimates can be made, landfill biogas based generation in California may rise to 500MWe from 150MWe in response to this price, and manure biogas generation coming online in response to price may be 50MWe (bases for estimates are presented in Note A-6). Sewage digester biogas based generation would also rise, to 50MWe. At 90% service factor, and assuming that the GEC applies to all electricity from biogas, the estimate of incremental cost due to GEC alone can be calculated as $ 75 million:

600MWe x $17/MWe(ave) x 8760hr/yr x 0.85 service factor = $75,949,200 (≈$75 million)

Administrative costs should be small as an increment, possibly the order of a few hundred thousand per year inasmuch as the GEC would be treated in parallel with the REC.

e.2 What cost-containment measures, if any, are provided?

A cost limit is inherent in adjustment of the GEC's as discussed in C-5 above. Several other factors inherently limiting cost of the obligation, as noted in the overview are competitive determination of GEC value (through the REC) and the size of the resource eligible for the GEC. Yet another factor limiting costs is the cost effectiveness standard imposed in terms of climate active gas abatement.

e.3 If the program utilizes floors for certain technology types, what are the implications in terms of costs and benefits?

The allocation of the GEC has effects somewhat akin to a floor, and results in abatement of climate active gas emissions from a source where it can be accomplished with maximum cost-effectiveness.

Another higher floor may be applied for technologies in earlier stages of development such as electricity from animal manures.

e.4 Will implementation lead to cost-shifting between consumers or regions of the state?

Not anticipated

e.5 How is competition within and between renewable technologies encouraged? Between existing renewables facilities and potential new facilities?

Generation of electricity from biogas would be favored over other renewables, by monetary value of the GEC/kWh (over the balance of non-renewable generation). However keeping the REC allocation (as percent of total power generation) for other renewables technologies constant, means competition between other renewables occurs essentially as it would without electricity from biogas. On the second part of the question, existing renewables facilities and potential new facilities would compete together for the same "customer" base.

e.6 What implications if any does the proposal have in defining the roles of the LDC and of competitive suppliers of electricity?

N.A

e.7 What is the consistency of this proposal in relation to cost-related guidance provided by the CPUC Roadmap?

N.A.

f. How does the Program fit with Other Aspects of Electric Industry Reform?

f.1 Is the system compatible with the existence of an independent system operator? A Power Exchange? A Direct Access Market? Is the proposal consistent with the Commission's vision of the role of the Power Exchange and ISO?

Compatibility with all of the above should be as with the approach using the REC alone.

f.2 Is the proposal dependent in any way on the power exchange or ISO? If so, are there any additional protocols necessary?

N.A.

f.3 Does the proposal involve conflicts of interest of interest between distribution and competitive retail service? If so, how are they resolved?

See AWEA

f.4 How does the program avoid conflicts of jurisdiction between state and federal levels?

No issue is envisioned that would not otherwise occur with a program based on REC's alone.

f.5 What is the relationship between the proposal and direct access "green marketing"?

The relationship would be the same as with other renewables proposals. Green purchasers may electively buy power from biogas (example was given in the text).

f.6 What is the relationship between the proposal and Performance Based Ratemaking (PBR)? Does the proposal place REC's under PBR or exclude REC's from PBR?

The UDC's (or other entities responsible for purchase of renewables or REC's) should not be financially penalized for swings or variations in the RECs or GEC precursors which they are mandated to purchase. Inasmuch as mandated for societal benefits, (i.e. public purpose) these costs should be passed through, directly or indirectly, to electricity end-users.

f.7 Does the program create any potential market power problems involving the generation market or REC's?

None foreseen

f.8 How does the proposal relate to any consumer protection or consumer education efforts? For example:

a. Rules for new entrants: Does the proposal require any licensing requirements for new entrants? Should compliance with the minimum renewables requirement be a condition of selling power at the retail level?

Consumer education: does the proposal require any consumer education? For example how does the proposal protect consumers from "green marketing" programs where marketers collect twice--once for credit sales and once for "green" power sales thereby not increasing total green power? This could entail, e.g., disclosure requirements to inform consumers about the amount of renewable green power they are purchasing that are supported by REC's or statements regarding price stability or price risk of the seller's resource portfolio. Would REC's accrue to utilities from green pricing programs where utilities have unique customer information and access?

Power sold at the retail level, by any seller, would need to be in compliance with the standard that develops. We note that consumer education issues should be essentially the same as with REC's

f.9 How if at all does the proposal relate to the RD&D programs funded by the public goods surcharge?

The proposal supports "bands" that would facilitate pre-commercial technologies. One specifically, is biogas from manure.

f.10 How, if at all, does the program relate to the energy efficiency programs funded by the public good charge?

N.A.

f.11 How does this proposal affect the CEQA compliance work recently initiated by the CPUC?

This proposal addresses what should be a central issue of utmost importance in the CEQA compliance work**:** the net emission of climate active gases by the utility sector. It also addresses air quality and other environmental benefits. It also incidentally, addresses emissions of a gas, methane , which participates in destruction of stratospheric ozone.

g. Legislative Requirements

g.1. Can the CPUC implement this program by itself, or is legislation required? What would the legislative requirement be?

It will only be stated here that the needs should be very similar to those involving an REC alone.

g.2. What steps are needed to implement the program and how long would it take? How does this implementation timing relate to the CPUC's 1998 implementation goal?

Probably close to the time that would be required to initiate a program based on REC's alone. We suggest (as does AWEA) that implementation be accelerated if possible--see AWEA.

4. Positions of the Parties: In favor/neutral/oppose

Comments of the CPUC's Division of Ratepayer Advocates, the Utility Consumers Action Network, and the Independent Power Providers

DRA/UCAN/IPP conditionally oppose this proposal because:

1. It adds unnecessary complexity. Biogas could participate in the AWEA-proposed biomass set-aside.

2. If, however, the Commission or the legislature approve a dual credit approach for biogas, DRA believes that it should be in the form of pilot implementation and that the biogas resources should receive general renewable credits, rather than biomass credits under the AWEA plan.

3. The pilot should last three years. Its costs and benefits should then be evaluated. The program may be renewed if the implementing agency is satisfied with the costs and benefits of the program. Preferrably, the pilot should be folded into any biomass set-aside that may exist.

4. The pilot program must not cause the rate cap to be exceeded.

Comments of AWEA/CBEA/GEA/STEA

OPPOSE. This partial plan proposes to give biogas double-value credits based on value of greenhouse gas abatement and extra cost of generation as compared to other renewable resources. Greenhouse gases are important, but are one of many values of renewables that are captured in proposal by AWEA, et al. Landfills are required to have gas collection systems and fuel is free. Thus, most biogas generation should be cheaper than solid-fuel biomass (which requires fuel collection, processing, transportation, and handling) and should be able to compete within the RPS with other renewables without a double credit.

Comments of the Surcharge/Production Credit Proposers

1. <u>Increases cost unnecessarily for customers:</u> Separating out a single environmental contribution (reducing methane emissions) claiming entitlement to additional program funds as well as adding special credit purchase requirements is unnecessary and exorbitant.

2. Gives unfair advantage to biogas over other renewables: Doubling credits makes biogas plants first choice for buyers over competition until requirement is met.

3. Needs funding as RD&D: If this technology is truly pre-commercial, as the proposal description indicates, the CPUC proposed Pubic Goods Charge is the appropriate funding mechanism or possibly special legislation is the vehicle.

Comments of the Union of Concerned Scientists

Oppose.
Pros: Accounts for greenhouse gas mitigation of biogas.
Cons: Does not systematically account for full range of externalities. Technology specific: does not offer same valuation for other technologies which mitigate release of greenhouse gases or offer other unique public benefits.

Comments of Southern California Edison

This proposal can be an add-on to any of the MRPR proposals. Its key feature is that it doubles the value of a kwh generated from biogas combustion. It also complicates the program. While turning biogas into electricity undoubtedly has its environmental benefits, it is questionable whether they should receive twice the credits of other renewable technologies and whether the additional program administration cost and complexity is justified.

Comments of Roy Sharp

I am involved in EPA's AgStar Program and speak for small biogas digester operators. For 15 years electricity from manure biogas has met our needs for 27,000 head on our swine operations, with excess sold to the grid.

The BWG proposal helps farmer's interests in dealing with odors and emissions. Energy use of biogas is a major part of the Climate Change Action Plan, and greenhouse gas reduction is strongly endorsed by utilities. All these benefits are appropriate to value monetarily in the electricity generated, under California utility code. The BWG proposal provides a win for everyone including the public.

Comments of John Palmer, Sacramento County Energy Manager

Sacramento County is interested in developing its renewable power resources to the extent that it is economically possible. There are substantial sources of landfill gas within Sacramento County that may be economic for us to develop with sufficient electrical energy revenues. We support the biogas group proposal which provides a revenue incentive that will help us develop our renewable resources as well as help the environment by preventing methane emissions.

Comments of SoCAL Gas

OPPOSE - This adjunct proposal tries to establish that biogas qualifies for special treatment as a renewable resource because it could play a major role in reducing methane gas, a major greenhouse gas and a contributor to global warming. It calls for a greenhouse environmental credit valued at twice the regular renewable energy credit. The proposal also states it should qualify for a higher subsidy because it is an emerging technology. This is an example of how costs to consumers are disregarded in favor of carving out a secure market for an expensive technology.

Comments of SDG&E

Oppose:

* No cost limitation.
* Unequal cost burden on consumers. Penalizes SDG&E's customers for not having previously been subjected to more high-priced ISO4s.
* Implements double subsidies above already-subsidized payments to existing biogas developers in form of RECs/GECs. Consumers would pay additional $47 million annually to existing landfill developers.
* Since this is a 12% MRPR proposal, the statewide cost to consumers would be $600 million annually assuming a REC value of 2 cents.
* Administratively burdensome and complex.

Comments of Biogas/Climate Active Gas Working Group on Their Own Proposal

This proposal points out that the California electricity sector can cost-effectively mitigate a major source of greenhouse gas emissions, while simultaneously generating a moderate share of California's renewable electricity. Facilitating electricity from biogas provides a bargain for ratepayers and the public in terms of greenhouse gas abatement, since it can offset a significant fraction of fossil CO_2 emission by the electricity sector at low cost.

Comments PG&E

PG&E does not believe that special recognition should be given to any particular renewable technology within an RPS or a surcharge methodology. It is difficult to determine exact preferences for any given type of renewable, since all provide different environmental benefits. Moreover, the weighting given to these benefits is always partially subjective and changeable over time.